

Friday 5 Nov 76

Also Aarhus Phys. 8 Sept 77

also Northridge
23 March 77

also Am. Nuclear Soc.
San Diego. 6 Oct 77

Directed Panspermia

George Scripps Inst. of Oceanography

Directed Panspermia.

Leslie Orgel. Erivan: Soviet Armenia: published in Icarus.

What is Panspermia?

Aerhenius - spores - light pressure
very unlikely

Meteorite Theory: again ~~is~~ very unlikely.

~~Does it?~~

Objection: only transfers the problem elsewhere

not resolvable: does matter where it started.

might have been impossible to start on their planets
only possible on another

mineral? ~~any~~ special compound?

etc.

UCSD
Physics
Coll.
Apr. 1977
The origin of life
Room 2622
USB.

Conditions for origin of our sort of life

Need water (ie. ~~not~~ a liquid, not a solid or a gas)

Then planet must be sufficient size
right distance from a star to give right temperature.
Star must not be too massive or its life too short.

our atmosphere is not the primary atmosphere but second air.
Need raw materials: if a reducing atmosphere also ① outer space
② volcanoes
then radiative ~~planets~~ etc → soup (Stanley Miller)
soup has suggestive raw materials. (Haldane)

How many planets satisfy these conditions?

$10^4 - 10^{10}$: stars in the galaxy.
% with planets? angular momentum?
double stars?

Arguments weak.

To which are just after a: probably at least 1%.

Then could be very many

What is needed for life (as we know it)?

- Accurate Replication - DNA (or RNA) a natural (Leslie O. will report progress)
- Mutation - no problem!
- Expression - now done by proteins.

How did protein synthesis start? (see page 2!)

Now need elaborate apparatus - like some, RNA, etc.

Could there have been a simple system? EXPAND

(Leslie b.)

But conclusion is that it might have been a common event

OR it might have been an extremely rare one
(proportion argument).

Thus either (1) life very common in galaxy

or (2) life very rare but

simple very common.

Note: Life very homogeneous (optimal activity & chance?) }
but genetic code suggests a bottleneck }

Time needed

Age of earth $4\frac{1}{2} \times 10^9$ (billion) years.

earliest organisms $\approx 3 \times 10^9$ years.

(real fossils $\approx \frac{1}{2} \times 10^9$ years)

cannot argue that it will always need this time

but not implausible that it needs times of this order.

Age of galaxy $13 \text{??} \times 10^9$ years.

need to ~~form~~ ^{for} early stars, to form high elements.

but then might also need 2×10^9 years.

Thus could have had early planets at 11×10^9 years.

ie. time for two generations (or even three?)

Picture of the others.

Their view of the galaxy - perhaps many sterile scaps.

Their missionary zeal

(psychology not understood!)

Not implausible they should try to start life.

How to transmit life?

Principle of Detailed Cosmic Reversibility.

ie. How would we do it.

Problem: the distances ; the time

delivery: the environment on arrival.

obvious idea to send microorganisms in an
unmanned rocket

= Directed Panspermia.

Why microorganisms? : can send v. many 1000 kg
 $\sim 10^{17}$ bugs.

can last very long & recover O.K.

can be delivered easily.

can adapt easily to early environment

Σ

manor 4th light year.
~ 1000 within 100 light years
possible.

The rocket problem

how fast? very fast → damage

too slow takes too long.

needs to be "home"

probably needs to decelerate

air for perhaps
100 light years.

{ 60,000 mph = 10⁶ years.
1/1000 light speed = 100,000 years.
1/100 = 10,000 years.

delivery ~ entry problem.

Main problems : to develop something better rocket
: to make them still work after a long
journey.

Why not mice or men? Science Fiction.

Bugs can always go further : EXPAND to 10⁴ years ahead.
EXPAND to 10⁶ years ahead.

also note that unlikely to be infected
by ~~low~~ higher organisms (unless from identical origin).

Thus theory is not ~~unreasonable~~ ridiculous

IS or Science Fiction? Numbers ~ hopefully verifiable in time

Any evidence? Polydesum?

The Homogeneity of life

same 20 cc.

~~the~~

|| The Genetic Code.

Appear to have arbitrary elements.

all messages a "bottleneck"

moon
rockets
swans

real moral is that subject a skill is
its early steps? - or we could ~~for~~ estimate
~~for~~ whether a theory was implementable or not.

Then need to pursue both approaches.

Orthodox approach - L.E.O.

Directed Panस्पemia: ~~rocks~~
Feasibility studies - rockets expand
- bus transport & life
- bus in soup

But plea not to underestimate the galaxy!

Wider question: are the others still there?
did they seed ~~of~~ many planets
or run out of funds!
When are those planets now?
is there a village in the galaxy?
(dispersion of stars?)

only time will show.